CONSCIOUSNESS IN THE BRUTES.[1]

By George V. N. Dearborn, M.D., Ph.D.,

PROFESSOR OF PHYSIOLOGY, TUFTS MEDICAL SCHOOL, BOSTON.

The brutes cannot tells us humans directly whether they are conscious or not, because they are "speechless" if for no other reason. Opinions on the matter range from that of the zoophilist, (who is apt to believe them all as richly endowed with thought and fancy as himself) to the occasional physiologist, now rarer and rarer, in whose vocabulary the term consciousness, save as the name of an epiphenomenon in man, a "secretion" of the brain, does not ever appear. Trite as the subject is, new biological view-points give the matter even a somewhat novel appearace and so lend new material to its philosophical discussion.

The problem may be approached from any one of at least three sides, or from all three. The first of these is that of untechnical common-sense, which means the pure reason beneath all our notions, some times at fault. By "the man in the street" the brutes are considered conscious as a matter of course, because he knows them to be built substantially like himself and because he sees them act practically as he would act under like conditions, if the conditions were not too complex or too abstract—and the average man knows himself conscious if he knows nothing else, this being the essence of humanity. The usual man then takes it for granted that the brutes, especially the "higher" brutes are conscious by the innate criterion of analogy, the perception of identity, by the doctrine of probability, by the inherent chances of the facts as he sees them. It is likely that no man could do better in principle than this, nor will he, until the protozoa learn to talk! The second side from which the problem may be approached is that of epistemology and metaphysics, and the more natural trend of this way of looking is toward pan-psychism, the climax of rational idealism, at no variance with science. A third way the matter may be discussed is in the light of biology, physiology, chemistry, and physics concurrently with psychology, the former gradually describing the details of the somatic process while the latter science analyzes even more gradually by the aid of experiment further and further into the description of consciousness —two "parallel" lines of details which persistently refuse, and more and more persistently, to "correspond." This third method of approach rests also on analogy for any satisfaction it may result in, but on an analogy so minute and sooner or later so complete that to deny its consequences as to the consciousness of brutes is mere obstinacy, the child's principle of self-supporting opposition. In theory, this method carried out fully would amount to a demonstration to everyone and be the best which we could hope ever to do. In practice, the details of the similarity in function and structure between man and brute are not so complete but that some still say, "We are conscious, but horses and crabs and butterflies are not," forgetful that this form of solipsism is natural although illogical, and that probably could they think and speak the horses and the crabs and butterflies would each so express itself of all outside the limits of his own communication. The evidence lacks only this mere affirmation of being universally conclusive. The present paper attempts to approach the question as to the consciousness of animals from what is practically this last direction. It is the viewpoint of the physiologist, the vivisector, the medical man, interested in the chemistry and the physics as well as in the gross and minute anatomy of animal bodies from ameba's to his own. It is also the viewpoint of the amateur psychologist *speculating* where experiment is vain.

---

[1] Read before the American Philosophical Association in Philadelphia, Dec. 29, 1904.

It seems to be more and more obvious that to trace out any sort of a one-to-one correspondence between the terms of the mind-series and the terms of a brain-series is impossible. Whether these two be considered as causally or only as concomitantly related, whether the viewer be materialist or pan-psychist, the members of these two empirical series cannot be made to correspond and the likelihood of tracing out any exact back-and-forth relation is more remote now than formerly, as detailed knowledge of the two orders of events increases. I say this probably too dogmatically for I say it somewhat feelingly, since the conviction comes to me I confess with a tinge of disappointment. I started out on this quest with a most unphilosophical but not unnatural bias, a firm presupposition as a matter of course that psycho-physical parallelism between nerve and mind was very probable and that only the details remained to be worked out. I have little idea how it is with my hearers, but in myself the more I racked my ingenuity in comparing the two series of processes back and forth, the better, too, the details of the two series here and there became known, the more hopeless the comparison seemed. Sometimes I tried to make myself believe that it was only because the details were so dim as yet, especially in the mental series, that the correspondence did not appear and the two halves fit together like the sunset sky and the skyline beneath it of hills and forest. This sort of harmony one would like to experience and add to his understanding of "things as they are"; it arouses one's scientific curiosity as few things beside and the sense of being baffled is correspondingly unpleasant. The pseudo-satisfaction of reducing consciousness to a process of cortical "associative memory," as is now the fashion among a certain school of physiologists, is a "satisfaction" as remote as any which can be imagined, for after all the brain is something different from a "phonograph," and mental process unlike vibrations.

Like many others then in the same dilemma, students of both mind and body, it seems to me inevitable that one should take refuge in a purely logical syllogism and conclusion that somehow or other there are not two series there at all, but only one, and that the other inheres in this, that the body is a phenomenal aspect of the mind or of mind. Idealism truly offers all men rational satisfaction (but least when we try to orient in it our own bodies), although at the same time we must sympathize with and try to satisfy the natural realist, and even the out-and-out dualist when he refuses to repress his human curiosity as to the magic means by which the reason so readily fools, or let us say outreasons, its hand-maid, sense. What the scientists need, indeed, to be taught by students of philosophy in return for facts, is the truth, the reality, and the importance of the idealistic view. Epistemology should not exist for students of philosophy alone, and should not for lack of cöoperation, be considered by the average biologist and physician and man of science a system of notions merely, pleasant to discuss sometimes, but useless after all. If idealism is worth its historic name, it is fit substratum for every science in the schools, and its principles simple in themselves lend simplicity to many a complicated scientific snarl. On the idealistic basis science gets a richness as well as a truthfulness which students of science should not be allowed by their instructors to miss out of their knowledge, a richness which develops into one's whole life.

The pan-psychistic aspect of the relations of mind and body as processes, fails to show to common sense (and it is common sense which most of us are trying to impart) a working hypothesis on which the scientific student may rest when, as usual, he is not in a metaphysical mood. And of course the scientific problem is quite independent of the philosophic problem though not of the philosophic student, for his puzzles are also in part those of the psychologist. So far as most of us know for a certainty, mind is inherent only in living tissues and it is inevitable that every active inquiring imagination should insist on some sort of parallelism if there is any sort of basis for any such conception. The fact that disembodied consciousness is to say the least doubtful and a body therefore always accompanying mind to say the least probable, makes this demand reasonable, and renders necessary some sort of parallelistic theory if mind itself is to be understood. The physiologist as a scientist is somewhat better off, more independent of mind than the psychologist is of body, as one sees evidenced in comparing the text-books of physiology with those of psychology and in observing therein that whereas the physiologies, the older ones, scarcely refer to mind, the psychologies, the newer ones, refer everywhere to the bodily substratum.

Notwithstanding this dependence of an adequate empirical psychology on the somatic process for guiding description in at least some directions, no one has ventured to attempt to define a plan for the psychophysical correspondence in general, and now the problem seems, as has been said above, further from solution than ever before although the light at present is greater than ever. Never before was so much really known about the nervous system with which it is customary to attempt to correlate mind, while systematized introspection continually shows us more of the molecules, so to say, of mind. Psychophysical parallelism must evidently take a new standpoint if it is to serve a useful explanatory or even descriptive purpose.

The reason for this failure of correspondence more and more lies partly in the change which our notion of the nervous system has undergone very recently. It has lost some of the former importance accorded to it in the hierachy of the tissues and organs. There are conditions inherent in the neurone theory of the structure of the nervous system which supported the belief that the neurones were in a way the physical basis of mind; for example, they allowed of a belief in the existence of perfectly definite centers in the brain and cord with which it was comparatively easy to imagine that various psychical functions, for example volitions, were connected in some way directly. Again, the nerve cells might be similarly used, while that fugitive retraction-theory of the neurones, although never really accepted as certain by anyone, doubtless helped to make more tangible a vague correspondence between a period of consciousness and the same period of the functions of the nervous system. Now the tendency is more or less away from the neurone theory. Many physiologists begin to see in the nervous system an immensely complex reticulum of very minute fibrils, combined mostly into axis-cylinders and here and there surrounded and enmeshed by masses of different yet neural protoplasm, the nerve-cells. These nerve cells are no longer considered by many as wholly the functional centers of the fibrils as a battery-element is the center of a telephone system, but appear rather chiefly as organs for controling the nutrition of the fibrillar network, having also important uses in cöordinating and changing more or less the impulses coming into them over the fibrils. In short, the nerve-cells no longer have in many minds the importance they seemed to have, while the fibrils, the conducting paths, have acquired new meaning. It is the white matter composed of fibrils which most largely serves the functions of the nervous system, the chief of these functions being to connect the separated parts of the body and the body at large with the sense organs by which it is related to its environment. These separated "organs" are not only the massive viscera, the muscles, the brain, etc., but they are also single cells and groups of cells in muscles, glands, and supporting tissues. From this point of view the important use of the nervous system is to connect, to cöordinate, and to adjust by its own control over impulses which are originated not within but outside of its substance, by forces either mechanical or chemical or electrical. It is, by the newer view, somewhat, but not much, more than a vastly complicated system of protoplasmic bridges connecting more or less active and extensive structures and the individual with its environment.

Some of these structures which the fibrils of the nervous system connect exhibit their lack of dependence. In other ways the predominance of muscular tissue in psychophysical processes is equally obvious. In the perception of space and of time every ultimate criterion is muscular in all probability, since time-perception depends on bodily rhythms and space-perception, largely at least, on movements (two-dimensional space getting its appreciation from eye movements and three-dimensional from the contractions of other muscles especially those of the arms and legs). Even monocular and instantaneous perception of depth may contain within it the universal influence of afferent and efferent impulses connected with the tonal or more powerful contractile movements of muscles. The category of causality seems to have a quite similar origin in the individual consciousness, the child obtaining this notion clearly only from his actual experience that he can cause changes and things himself by the actuation of his muscles. Thus the muscles, more than half the weight of the body, concern themselves most intimately with the most basal categories of the mind, which develop as the muscles' use and control develop in the child. The unstriated and involuntary muscles differ in no wise from this in principle, since they appear to represent only another form adapted by force of the law of habit to work even more automatically on its services very readily, for example the heart and the glands. We need not review the large amount of work on the contraction of muscle lately performed; here it is sufficient to summarily say that it is now known that practically all the unstriated muscle of the body, and the heart (although partaking of the nature of striated muscle) can carry on their rhythmic action indefinitely when supplied with nutriment, heat, etc., without nervous control; of this the heart's apex, containing no known neural tissue, is the most striking example. If we transfer our attention to the protoplasm of simple animals instead of to the tissues of the "higher" forms, we find quite analogous results. Thus Yerkes studying the movements of the medusoid Gonionema (a jellyfish-like animal of common occurrence), finds that the reactions of special organs or parts are not dependent for their execution upon the functional activity of the central nervous system, nor spontaneity of movement, nor cöordination, but that this last depends rather on the rapid transmission of what is probably a muscular impulse, the others on stimuli inherent in the tissue itself (that is on nutriment, ions, or what-not). In short the tissues and smooth muscle in particular are automatic and depend on the nerves probably only for cöordination in cases where the impulses would not be carried fast enough through the protoplasm itself, undifferentiated into a conducting tissue. So far as the process of secretion by epithelium is concerned it is nothing at all new that the varied chemical reactions go on quite independently of nervous influence save that which regulates their supply of nutriment and that which controls the health of the protoplasm perhaps. This secretory process is next in importance to the contraction of muscle.

Thus the nervous system is gradually being forced into its proper place as a series of protoplasmic connections between parts of tissues other than itself. If a blow on the forehead causes the so-called loss of consciousness while an equal blow on the thigh would cause only pain, it is perhaps because the blow in the former place by its concussion disturbs the nutrition of and partly disorganizes a multitude of connecting fibers each bearing an important message, while the blow on the leg disturbs relatively few connections and so causes "loss of consciousness" only in the foot perhaps or up and down the leg. The nervous system connects, cöordinates, and adjusts the influences given out by the body's varied bioplasm. What it conducts it does not create (save in the sense discussed below)—it is at least as passive as it is active. Its business is largely conduction, and in doing this it gives the semblance of representing mind, partly because the association of ideas does perhaps depend at once upon it, and partly because the totality of a continuum, such as consciousness empirically is, demands a unification in the physical basis which unification it is certainly the function of the conducting nervous system to supply.

In the hierarchy of the tissues of a mammal or even of any vertebrate there are properly grades of value if we make active service the criterion of usefulness. From such a viewpoint the muscles are the master tissues, as indeed Foster calls them, for it is they which most serve the purposes of the individual. Besides, epithelium supplies the chemical products used in the organic machine, the nervous system cöordinates and adjusts "internal relations to external relations," the connective tissue binds the parts together structurally as does the nervous system functionally, the bones support the body, etc. Formerly, not too long ago, the nervous system was supposed to dominate and control the whole, not only cöordinating but directing, the one tissue in command, nearest to the soul, immediate agent of the individual will.

Sometimes, as a mere matter of feeling, if you please, it seems absurd to try to define any sort of correspondence between the quite indescribable sentient experience and the body at all. Such an attempt seems a contradiction. The sort of localization which would call what we know as consciousness a product of the material process seems almost an indignity, an insult, and the impression is not premeditated but comes from an underlying awareness of the utter contrast of the two kinds of events when looked at casually, phenomenally and compared. Who can imagine even that the manifold of joy and sorrow, heaven and earth, past and present and to come of that we know and feel as *life* is the outcome, the accompaniment even, save as cause, of a small complex of physical currents or of vibrations in a brain? In some moments such a comparison seems sheer nonsense and absurdity, and in proportion to the smallness of the supposed accompanying mass, to the simplicity of the supposed accompanying process do the absurdity and the nonsense of such attempts impress the mind. Only on empirical evidence which cannot be denied is a psychophysical correspondence believable or even supposable at all.

The notion of Descartes that the soul had its seat in the pineal "gland" we hear now-a-days most often with a tendency to smile and yet this mode of thinking is not wholly outgrown as is evidenced by the present habit of locating consciousness in the nervous system, or even in the cortex of the brain. The absurdity of Descartes's supposition lies largely in the small size of the pineal gland—there is an inevitable feeling that the more definitely localized we consider consciousness the closer are we to the old outworn conception of a substantial soul. Yet the customary mode of viewing the matter is not much different, only that now the location has been extended to a brain cortex whose gray matter, even in man, weighs only about one-fortieth of one per cent. of what the body weighs and whose energy is in little if in any larger proportion. The action of the white matter is apparently as passive as that of any tissue in the body, so that although quite unmeasured it is insignificant compared with that of the easily fatigued and injured gray matter in the nerve cells. But I for one practically am quite as unable to relate consciousness to the seventeen grams of gray matter in the human cortex as to the two or three grams of the pineal gland although theoretically the former sort of tissue has claims which the unnervous tissue of the conarium does not possess. Consciousness has the earmarks (they may be specious) of experiences we know as forceful or energetic, and it is not easy to see how so little energy in a supposed physical concomitant could stand for experiences at times so overwhelmingly significant and powerful. But if we realize that the nervous system is the more or less passive distributor of impulses and influences which originate without its area in other sorts of protoplasm, we shall grade its status more rightly. It is obvious that such is the case with those two large thirds of consciousness called feeling and will, for much research has shown conclusively that when feeling or willing is at all predominant in a period of consciousness, that practically every portion of the organism is concerned either actively or passively, in either case causing mechanical changes and the stimulation of a myriad sense organs in all the tissues. How greatly indeed feeling and will as aspects of mind predominate over cognition we all realize, so that one is bound to admit, if he realizes how perfect a unit the body is, that much of its protoplasm is concerned in nearly all of consciousness. Two theoretical aspects of mind, however, namely, "pure thought" and " pure sensation" are apparently relatively confined to the nervous system, without involving protoplasm outside it. The former of these, thought, we shall consider later on; the latter, pure sensation unaccompanied by elements of will or of emotion, is an abstraction as you all realize for descriptive purposes only, rarely or never experienced, for on the one hand the personal element is always present in greater or less degree, and on the other hand it is only practically under artificial conditions that one sense organ or even one sort of sense organ only is stimulated. But suppose a single pain-spot on the skin to be incited to action and that affective elements in the consequent consciousness are absent,—even then the stimulation would only serve to direct the attention, the focus of consciousness, without involving the great sensation-mass, for the instant submerged but by no means abolished, as experiment readily shows.

Another problem germain to the question of how far the nervous system is adequate to represent consciousness in all sorts of animals depends on that rather intangible inquiry as to the extensity of consciousness, or rather perhaps, more precisely, as to its having or not having as its basis a sensation-mass, although the two problems are not theoretically quite the same. Is empirical consciousness like the electric currents darting singly here and there over an intricate system of telegraph wires, bearing with them meaning of various sorts and one always more conspicuous than the rest, or is it more like the mass of water making up a brook? In other words, has consciousness only time-relations and intensity or has it, is it, also something comparable in a figurative sense to mass or substance as well as time relation, intensity, and relative degrees of meaning? Is the varying focus of attention all, or is there behind and beneath the attention focus of the moment a sort of sensational substance like to a process? Is it phenomena or noumena? Only a meaningful direction of experience or a meaningful reality? I for one confess my entire inability to see it other than in the latter light, something real and essential because complex, index of all reality besides, and in a strictly figurative sense massive and substantial, made up mostly of sensations.

The simile of the brook has much of suggestiveness in it — the physical basis beneath it, the mass of on-flowing subconsciousness here and there disturbed by bodily conditions and determining largely the waves of attention on its surface, although these are susceptible readily also to stimuli from without —all this is a simile which is perhaps not only suggestive but to a degree descriptive. Consciousness has a measure of extensity. Even when the narrow ear drums receive the stimuli we notice it, for we distinguish a difference between the violin solo and the music of thirty playing in unison aside from that of intensity, while the difference between a burn on the finger-tip and the sensation coming from sinking into a bath of hot water is one of extensity almost wholly. No explanation of this difference is so close at hand as that based on a limited atomism in consciousness, but an atomism which the nervous system is quite inadequate to represent. Witness the astonishing phenomena of the sub-conscious mind; hypnosis, split-off consciousness or personality, automatism, and even of normal sleep and its varied puzzles in psychology. These have begun to reveal to us that consciousness has a basis and that in itself it is complex and multifold. Somehow the consciousness so exhibited has too much of something akin to extensity to be represented by the disparate currents along isolated neural fibers or in nerve cells, particles of neural protoplasm scarcely less minute and themselves made up mostly of fibrils. This complexity and this extensity argue for some sort of representation in the animal body outside of a system of only trivial mass and metabolism. Considered so, parallelism takes on a new sense, the details of which because of their minuteness and complexity may never be laid bare, no microscopes corresponding to those which explore the structure of the tissue cells being at hand to apply to conscious processes. In this way of seeing the theory of psychical atomism, even, so much derided formerly by some, acquires some sort of real significance, for beneath the discrete elements of consciousness is the cellular atomism, so to say, of the animal body.—both body and consciousness being empirical continua with more or less corresponding relations, each composed of parts not obvious to the unanalyzing view yet each an individual series of empirical events.

(To be Continued.)